PUBLISHABLE SUMMARY

Objectives

The expected introduction of fully electric vehicles puts a significant additional demand on electricity production plants and distribution grids. This major change on the electricity demand side occurs at nearly the same time as an expected shift from stable to partly variable supply input, caused by the extension of renewable production capacities. It is therefore essential for the viability of these developments that the electricity production and demand sides become better coordinated. The Vehicle-to-Grid (V2G) interface concept is an essential mechanism for such coordination.

Regarding the automotive aspects of electric vehicles, their limited driving range is one of the biggest deployment challenges. For mitigating this restriction, it is essential that owners should be able to recharge their electric vehicles not only at home, but also at their destination, namely at parking garages near their offices or near train/subway terminals. The Vehicle-to-Grid (V2G) interface concept is a mechanism for supporting this paradigm of nomadic electricity consumers. This new paradigm however raises questions about the architecture of measurement and billing components, as well as the involved value chains. A suitable design of the V2G interface shall support nomadic electricity consumption under any foreseen arrangement of the billing architecture or value chains.

For achieving the above described V2G-enabled benefits, the scope of PowerUp project is to develop and validate the V2G interface. PowerUp progresses through a full development cycle of physical and link-layer interface specification, protocol design for scheduling of recharging and for accounting control, prototype implementation, conformance testing, integrated field trials, and standardisation. The standardisation scope covers both the standards for the new interface between vehicles and local smart meters, as well as enhancement of existing smart metering standards for V2G. Simulations on the effects of large-scale V2G deployment and extensive consultation with both vehicle manufacturers and utility operators are complementing this planned development cycle.

The main focus

PowerUp results provide the automotive and electric utility communities with the following:

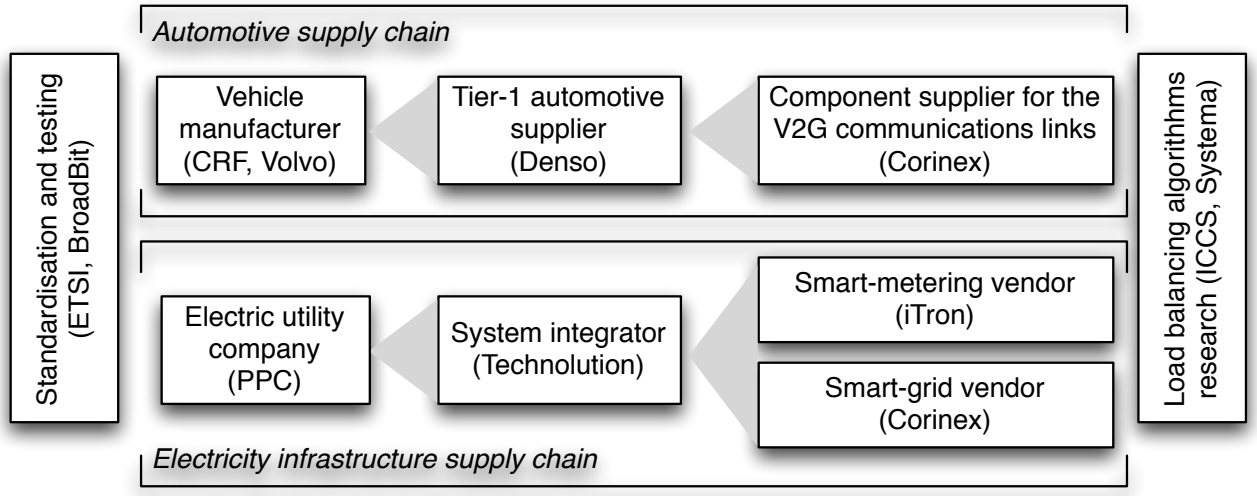
- **Specification of the V2G interface**; a self-contained 'consensus' specification of the V2G protocol stack, and EV-specific smart-metering extensions. The ISO/IEC 15118-2 (V2G) draft standard and the IEC 62056 (DLMS/COSEM) standards are taken as specifications baseline. The proposed enhancements to the above-mentioned protocols - which are identified as a result of PowerUp research - are being contributed back to the IEC TC69 and IEC TC13.
- **Automotive V2G adapters** for EV integration and **V2G ready electricity meter prototypes**. The automotive V2G adapter prototypes are integrated with the battery control unit and the user HMI. These components may be used by EV related follow-up field trials.
- **End-to-end demonstration of the V2G system**; this may also serve as a model for follow-up field trials
- **V2G interoperability testing capability**; relevant for compatibility of follow-up multivendor products.

The project consortium and work plan

Project duration: July 1, 2011 - June 30, 2013.

The following figures show the project consortium according to the role of partners and by business domain. The PowerUp consortium represents the full supplier value chain in both automotive and electricity grid domains.

Participant organisation name	Role
BroadBit Slovakia	Coordinator
Centro Ricerche Fiat	Vehicle manufacturer
Corinex	PLC/smart-grid developer
DENSO AUTOMOTIVE Deutschland GmbH	Automotive supplier
ETSI	Standards Development Organisation
Institute of Communications and Computer Systems	Load balancing research, Quality mgmt.
Itron	Smart metering vendor
Systema	Load balancing research
Technolution	System integrator
Volvo Technology	Vehicle manufacturer
Public Power Corporation of Greece	Electric utility



The accomplished project work involves 253.5 person-months of total project effort. The work began with collecting Use cases and requirements, and then proceeded to specifications and prototyping. The final phases of the project involve system integration of prototyped components, demonstrations, and development of V2G test specifications.

Potential impacts

The PowerUp specification results - which contain improvements and extensions over the V2G and Smart Metering base standards - are being contributed to the IEC TC69 and IEC TC13; thereby these specifications can become the basis of upcoming V2G product development. The TTCN-3 based V2G testing suite can be used at ETSI for future V2G interoperability plug-tests;

this activity will help V2G device suppliers to ensure standards compliance and interoperability of their V2G implementations.

The V2G interface adapter prototypes developed in PowerUp can be used for V2G field trials and the related know-how gained by project participant will be utilised in the course of follow-up V2G product development phase.

The main project results

The most important project outcomes include the following:

- Prototyping of automotive side V2G interface adapters, including integration with battery management and HMI.
- Prototyping of infrastructure side V2G interface adapters, including integration with Smart Meters.
- Prototyping of PowerLine Communications media conversion and Pilot Control Function, specifically demonstrating deployment scenarios co-existing with UPA, Home-Plug, or G3 infrastructures.
- Completion of the TTCN-3 based V2G conformance testing suite

The public project deliverables have been also published on the project website, which is found at www.power-up.org.